Psychological and Sociological Origins of Modern Science

Lewis Feuer's book, **The Scientific Intellectual: The Psychological and Sociological Origins of Modern Science** (Basic Books, New York, 1963. 455 pp. $10), has the merit of having been written with zeal for its leading idea. The author attacks the correlation between the Protestant ethic and the social development of science since the 17th century. That relationship has been accepted by scholars, very widely indeed, ever since it was extended to the sociology of science from Max Weber's famous analysis of the spirit of capitalism, most notably by the work of Robert K. Merton. Feuer is against all that. He will not allow any sort of religious motivation, whether it arises in Protestant, Catholic, or Jewish contexts, to have had genetic or favorable effects in the birth or growth of the sciences. Ascetic practice, mystical experience (or, in his view, fantasy), belief in a god or a reality not of this world—these elements of religion have inhibited science, both in themselves and in their psychic and social consequences. In effect Feuer's book is an attack, not simply upon the Weber thesis applied to science, but upon the religious components of civilization in general. He seems to prize rather those aspects evident in the works of Freud, of Marx, and of Rabelais.

These preferences make a curious blend. Thus, far from having been the fruit of puritanical codes of conduct, science—so Feuer insists throughout his book—has come about as an expression of a "hedonist-libertarian ethic." Such is his enthusiasm for this notion, such the wealth of frisky anecdote, that a reader lulled by his prose, which deploys terms from sociology and psychoanalysis, might lower his guard and easily emerge with a vision, a liberally hyphenated vision, of scientists wining, dining, and wenching their way through history, the while secreting experiments, equations, and even theories. Newton, of all people, is made out a hedonist on the ground (not very securely established) that he connived at an illicit liaison between his niece and Lord Halifax. Little else is said about Newton or his work or about the work of other scientists, however, and somehow one remains unconvinced of their gaiety. After all, one's impression of scientists, whether one considers them today or in history, is seldom hail-fellows-well-met. Still, this is not what Feuer really means to say, and there are in his book propositions worth considering seriously.

Before indicating them, let a historian of science distinguish those matters whereof the treatment saps his confidence from those which seem interesting. It appears to be a fundamental assumption of this work that, in order to judge a cultural achievement, we must analyze not so much the work itself as the emotional state in which it was produced. The book labors, therefore, under the disadvantage that attaches to any venture which entirely and even in principle passes over the content of science in favor of its circumstances—in this case the psychic and social circumstances of its creators. Throughout, the discussion seems to me marked by historical and philosophical naiveté, compensated (or intensified?) by exaggerated confidence in the categories of psychoanalysis. This remark is not intended to denigrate psychoanalysis as an instrument of healing, in which capacity it is often no doubt a beneficent technique, but only to question its suitability as a mode of historical explanation.

Skepticism arises most pressingly with respect to the psychoanalysis of ancient and medieval philosophy in a chapter called "The nominalist recovery of the sense of reality." Others on a supposed ethic in the Copernican revolution, on Vesalius and his feeling about sexual organs, and on the scientific movement in 17th-century England traverse well-trodden paths, not unacceptably, given the approach of the work as a whole. An account of the French Revolution and science is uninformed; one on Oriental science—"The masochist mode of perception in Asian civilizations"—deals with materials not controlled by scholarship. A long discussion entitled "The comparative sociology of science" is a somewhat incoherent summons to an important subject, juxtaposing sketches of scientific culture at strategic junctures in Islam, Alexandria, Spain, Portugal, Scotland, Sweden, Switzerland, and Holland.

Two valuable chapters seem to me really excellent. One is on the efflorescence of science among the Jews in the wake of the breakdown of Talmudical rigidity during the last century and a half. The other discourses of the "scientific intellectual" in American history. In both the author seems at home with his materials, which here, as elsewhere, are mainly secondary sources. Though doubtful about much else, moreover, I am entirely at one with him in his epilogue on the menace to any civilizing mission for science which is contained in its recent enlistment in military service.

What is to be said, finally, of the leading idea? For there may well be something in it. It is true that the putative Puritanism of the founders of the Royal Society does not withstand Feuer's scrutiny. Others have occasionally questioned that correlation. Probably it is too pat. Probably some of us have accepted it too easily. It is a pity that Feuer does not cite a modest and careful article which effectively calls it into question [T. K. Rabb, "Puritanism and the rise of experimental science in England," *J. World History* **7**, 46 (1962)]. On the other hand, it is also true that, as Feuer says, there has been some kind of association between science and secularity, secularity and liberalism, and science and liberalism.

That association probably has turned on the ethical as well as the physical appeal of the Epicurean tradition to the succession of students of nature or humanity who, for want of a happier term, may be called "scientific intellectuals." Precisely what those associations have been, what the ethical and what the physical components, what the measure of moral appeal and what of practical advantage, in what degree science, abstracted from philosophy and related either to measure-

ments at one extreme or emotions at the other, may be properly considered intellectual at all—these are problems for other, better informed studies, and, unfair though it may be to say so, since Feuer is certainly provocative and provoking, these will perhaps be studies written from a more conventional and more generally credible point of view than that of psychoanalysis *post mortem*.

They will almost certainly also be studies that will treat the circumstances of science relative to its content.

CHARLES C. GILLISPIE
Program in the History and Philosophy of Science, Princeton University

Crystal Lattice Defects

Proceedings of the International Conference on Crystal Lattice Defects. Supplements 1, 2, and 3 of the *Journal of the Physical Society of Japan*. Physical Society of Japan, Tokyo, 1963. Suppl. 1, 201 pp.; Suppl. 2, 360 pp.; Suppl. 3, 379 pp. Illus. Paper.

The international conference on crystal lattice defects was divided into two parts, topically and geographically. The first part met in Tokyo to discuss the mechanical aspects of defects, and its proceedings are contained in Supplement 1. Of the 34 papers presented in that supplement, about half describe theoretical and experimental studies of the motion of dislocations and their role in determining the strength and age hardening of metals and nonmetals. The remainder consider the point defects that normally accompany dislocations and their effect on internal-friction measurements, with special emphasis on the Bordoni peak.

The second part of the conference was held in Kyoto and concerned itself with more general aspects of defects, not directly related to studies of mechanical behavior. As an indication of the breadth of this conference, consider the 71 papers in Supplement 2. They can be loosely grouped in the following categories: electrons and phonons, their origins and interactions with each other and with other defects; thermal conductivity; point defects, their formation, migration, and contribution to conductivity and their observation by magnetic resonance and optical methods; color centers and luminescence; observation of lattice defects, mostly dislocations, by means of x-ray diffraction, field-ion microscopy, and other methods. The 72 papers in Supplement 3 are formally divided into two groups: (i) interactions between lattice defects, which contains 30 papers that are largely concerned with point defects and their role in various phenomena not already considered in Supplement 2, their interaction with dislocations, and a variety of topics ranging from crystal growth to dielectric relaxation measurements, and (ii) production and annealing of lattice defects, which contains 42 papers dealing with radiation damage in crystals, the defects produced and the methods for detecting these defects, as well as the phenomena that occur when damaged metals and nonmetals are annealed. As in other categories, various methods, materials, purposes, and end results are described.

The collected papers not only vary widely in content but also in the depth and breadth of coverage. Collectively, they accurately reflect our present knowledge of defects in crystals. Individually, they may or may not be sufficient to satisfy the reader's curiosity. If all the references cited are considered in evaluating this collection, however, then it can be recommended as worthwhile reading not only for the initiate but also for the neophyte. Even a casual examination is recommended, if only to illustrate the variety that exists in this field, less than three dozen years after its inception. The variety is particularly impressive when we realize that there exist other problems involving defects, problems that this conference did not consider.

LEONID V. AZAROFF
Metallurgical Engineering Department, Illinois Institute of Technology

Sigma Xi-RESA Lectures

Science in Progress. vol. 13. Wallace R. Brode, Ed. Yale University Press, New Haven, Conn., 1963. xiv + 305 pp. Illus. $7.50.

To the volumes of *Science in Progress*, the 12th of which was very recently reviewed in *Science* [**140**, 627 (1963)], may now be added the 13th volume. This collection of Sigma Xi-RESA lectures, again edited by Wallace R. Brode, contains the National Lectures delivered during 1961 and 1962.

A pleasant innovation is the inclusion of Alan Waterman's address at the annual convention of the RESA, on the occasion of his receiving the William Procter Prize for Scientific Achievement. Waterman's account of science in the 1960's deals not only with the present, but reaches back into history, and, more importantly, looks penetratingly into the future, where new breakthroughs are surely just around the corner. Erwin R. Biel outlines some important practical applications of new (and to many, surprising) discoveries in the fields of microclimatology and bioclimatology. Norman F. Ransey discusses molecular properties, formerly unobservable in dense gases or in liquids, but now ascertainable by the use of the molecular beam-magnetic resonance method. Sydney Chapman's beautifully illustrated and poetic chapter deals with the aurora borealis produced by the partnership of sunstorms and the magnetic field that emanates from the liquid core of the earth.

Theodosius Dobzhansky faces the dilemma that results from the continued occurrence of mutations with harmful effects, on the one hand, and medical and social progress, on the other, and discusses the present action of selection on man. Culture is deemed by far the most potent adaptive mechanism that has emerged in the evolution of life, and man's success as a biological species is attributed to the fact that his culture is able to change ever so much faster than his genes can. Future evolution will be attuned to our human values. Lloyd M. Beidler emphasizes the fact that all organisms live in a chemical world, and that the detection of chemicals is an important necessity in many animals. He outlines our present knowledge of taste and offers new biophysical approaches to the study of this important chemical sense.

Jesse L. Greenstein takes us on a telescopic journey through enormous reaches of space and time and discusses, in a most understandable way, the evolution of stars and the origin of the elements. Sanborn Brown introduces us to the newly appreciated state of matter—the plasma state—and acquaints us with its implications. Many scientific problems that arise from this recently acquired knowledge are outlined, including the very practical problem of controlling and harnessing the power of thermonuclear fusion.

Harrison Brown reminds us that the invention of agriculture, which oc-